PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference 2003221	FOR FURTHER ACTION See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)	
International application No. PCT/ES 03/00117	International filing date *(day/month/year)* 14.03.2003	Priority date *(day/month/year)* 14.03.2003
International Patent Classification (IPC) or both national classification and IPC G06T17/20		
Applicant CASTANON FERNANDEZ, Cesar		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 6 sheets, including this cover sheet.

   ☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of 4 sheets.

3. This report contains indications relating to the following items:

   - I ☒ Basis of the opinion
   - II ☐ Priority
   - III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   - IV ☐ Lack of unity of invention
   - V ☒ Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
   - VI ☐ Certain documents cited
   - VII ☐ Certain defects in the international application
   - VIII ☐ Certain observations on the international application

Date of submission of the demand	Date of completion of this report
12.10.2004	15.06.2005
Name and mailing address of the international preliminary examining authority: European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized Officer Klemencic, A Telephone No. +49 89 2399-6007

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/ES 03/00117

I. Basis of the report

1. With regard to the **elements** of the international application *(Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17))*:

Description, Pages

1-15 as originally filed

Claims, Numbers

1-13 received on 23.02.2005 with letter of 21.02.2005

Drawings, Sheets

1/9-9/9 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
- ☐ the claims, Nos.:
- ☐ the drawings, sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)).

   (Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	1-13
	No:	Claims	
Inventive step (IS)	Yes:	Claims	1-13
	No:	Claims	
Industrial applicability (IA)	Yes:	Claims	1-13
	No:	Claims	

2. Citations and explanations

   see separate sheet

Re Item V

Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1 Prior art documents

Reference is made to the following documents:

D1: US 2002 072 883 A1
D2: US-A-5 844 564
D3: US-A-5 740 342
D4: US-B1-6 256 603
D5: US 2001 056 339 A1

2 Clarity, Article 6 PCT

Claim 1 is not clear *per se*, because the general context of the application is missing. Claim 1 refers to 'a three-dimensional body', but from the text of the claim (or any of the subsequent claims) it is not clear that this three-dimensional body is actually a layered geological structure i.e. a mineral layer. The features 'physico-chemical properties' and 'bores' hint at layered geological structure, but do not sufficiently clarify the claim.

If the size, accessibility and manipulability of the object is ignored in claim 1, than the claimed method could be applied to a small, hand-held object. However, in case of a small(er) object one could bore that object from any direction, not just from the top, like in the case of the mineral layer, but also from the sides and the bottom. And in that case the method would fail, because it would not be possible to define the surface in the spatial centre along two main directions, which are primarily defined by the position of boring machines. In case of a ball shaped object the surface would be reduced to a point in the centre, in case of a rotationally symmetric object, the surface would be reduced to a line.

Above mentioned clarity objection can easily be removed by writing in claim 1 that the method applies to determining physico-chemical properties of the layered geological

structures i.e. a mineral layer or body.

3 Novelty and inventive step, Articles 33(2) and 33(3) PCT

3.1 If the above mentioned clarity objections are removed, then the subject-matter of claims 1-13 fulfills the requirements of Articles 33(2) and 33(3) PCT.

3.2 **Technical Field**: Determination of physico-chemical properties of a 3D body (i.e. layered geological structures).

3.3 **Closest Prior Art**: Document **D4** is considered as the closest prior art and discloses a method of acquiring and interpreting the geological data in order to build a geoscience model and applies a simulator to obtain synthetic data. Based on the difference between the measured and synthetic data the geoscience model is improved. Like some other documents in the field (**D1-D3, D5**) it uses finite element mesh or a finite difference models to generate the geoscience model of the subsurface structures.

3.4 **Problem**: Find an alternative way of calculating physico-chemical properties of the layered geological structures.

3.5 **Solution**: Based on the bores define a surface in a spatial centre of the geological structure, generate new grid points on that surface and interpolate the data to these new points.

3.6 **Novelty and inventive step**: Cited prior art documents use meshes to describe the subsurface structures. None of them discloses or hints at the construction of the central surface, which seems to be novel and inventive feature of this method.

4 General remarks

4.1 Contrary to the requirements of Rule 5.1(a)(ii) PCT, the relevant background art disclosed in document **D1** to **D4** is not mentioned in the description, nor is this

document identified therein.

4.2 Independent claims are not in the two-part form in accordance with Rule 6.3(b) PCT. In addition, the applicant should ensure that it is clear from the description which features of the subject-matter of claims are already known in combination from the document **D4** (see the PCT Guidelines, III-2.3a).

CLAIMS

1. Method for determining physico-chemical properties of a three-dimensional body, said method comprising the following steps:

a) generating a first database (**BDS**) that contains first data on bores intersecting said three-dimensional body, said first data defining the location and physico-chemical properties of the three-dimensional body at said bores,

b) defining a first surface (**T1**) in aspatial centre of the three-dimensional body by triangulation, so that said first surface (T1) extends along two main directions of said three-dimensional body,

c) defining on said first surface (**T1**) a cluster of points (**NPS**) generated with regular spacings in said two main directions of the three-dimensional body,

d) generating, by creating linked triangles between the points of said cluster of points (**NPS**), a second surface (**T2**) constituted by said triangles,

e) calculating, by an interpolation method and based on said first data in the first database (**BDS**), second data defining calculated physico-chemical properties of the three-dimensonal body at said points of said cluster of points (**NPS**),

f) generating a second database (**BDT2**) using the triangles constituting said second surface (**T2**), so that said second database contains, for each triangle constituting said second surface (**T2**), the coordinates of the vertices of the triangle, the second data defining calculated physico-chemical properties of the three-dimensional body at said vertices of the triangle, and the area of the triangle in space,

g) generating reports with information from the second database (**BDT2**), and

h) generating three-dimensional graphical representations based on the second database (**BDT2**).

2. Method according to claim 1, wherein the first database (**BDS**) comprises the following data:

- data on coordinates defining the position of the intersection of each bore (s1, s2) with the three-dimensional body, wherein the coordinates can

either define a single point determining the centre of the body at said bore or an interval determining the beginning and the end of the three-dimensional body at said bore,

and

- the data on physico-chemical properties of the three-dimensional body (data 1, data 2) at each bore.

3. Method according to any of the previous claims, wherein the first surface (**T1**) is generated by applying the triangulation method based on the coordinates of the centres of the bores, and, optionally, further based on three-dimensional interpretation of known data of this body and previous knowledge of a usual shape of the corresponding type of body.

4. Method according to any of the previous claims, wherein the cluster of points (**NPS**) is generated by an algorithm based on regular spacings on the surface.

5. Method according to any of the previous claims, wherein in step d), a triangulation algorithm based on the cluster of points (**NPS**) is used to generate the second surface (**T2**) .

6. Method according to any of the previous claims, wherein, in step e), the second data for each point of said cluster of points (**NBS**) are calculated based on the first data corresponding to surrounding bores.

7.- Method according to claim 6, wherein for calculating said second data for any point of said cluster of points (**NBS**), an interpolation method is used by which the second data for said point are set to be equal to the corresponding first data corresponding to the nearest bore.

8.- Method according to claim 6, wherein for calculating said second data, for any point of said cluster of points (**NBS**), said second data for said point are set to be the arithmetical mean of corresponding first data corresponding to bores within a

maximum distance, weighted by a power of the inverse of the distance between said point and the respective bore.

9.- Method according to claim 6, wherein for calculating said second data, for any point of said cluster of points (**NBS**), a geostatistical method, such as Kriging, is used.

10. Method according to any of the previous claims, wherein the graphical representation generated in stage h) from the second database (**BDT2**) is performed by graphical software that allows the three-dimensional representation of the shape and properties of the three-dimensional body.

11. Method according to any of the previous claims, said method being a method for determining the mineral resources or reserves of a mineral body or layer, wherein the first database (**BDS**) is made to contain data on the intersections of the bores with said mineral body or layer, this database comprising:

- data of coordinates defining the intersection of each bore (s1, s2) with the mineral body or layer, wherein the coordinates can either define a single point determining the centre of the body at said bore, or an interval determining the beginning and the end of the three-dimensional body at said bore, and
- data on the physico-chemical properties of the mineral body or layer (data 1, data 2) at each bore (s1, s2).

12.- Method according to claim 11, wherein in step b), defining the first surface (**T1**) is made by forming linked triangles between the median points of the intersection of each bore (s1, s2) with the mineral body or layer, by using the centres of the intersections of the bores with the mineral layer, the information on any outcrops of the layer and geological interpretation regarding the spatial location of the layer, whereby a set of points and lines are defined located on a central surface of the mineral body or layer, and using these points and lines, so as to form a surface by triangulation, providing a set of linked triangles in the space, whereby sufficient points and lines are added so that the surface generated by triangulation is a faithful

representation of the centre of the mineral layer or body and covers the entire area to be studied.

13.- Method according to any of claims 11 and 12, wherein the cluster of points (**NPS**) is generated applying the following steps:

- an algorithm is used to fill in the first surface (**T1**) with points that are more or less equidistant to one another,
- the distance between the points is defined according to a calculation detail required so that its final three-dimensional representation agrees with an initial interpretation of the layer,
- whereby, depending on the algorithm used, the real distance between the points is not necessarily always the same.